ANN BAVENDER*
KAREN L. CASSER*
ANNE GOODWIN CRUMP*
VINCENT J. CURTIS, JR.
RICHARD J. ESTEVEZ
PAUL J. FELDMAN*
ERIC FISHMAN*
RICHARD HILDRETH
FRANK R. JAZZO
ANDREW S. KERSTING*
KATHRYN A. KLEIMAN
EUGENE M. LAWSON, JR.
HARRY C. MARTIN
GEORGE PETRUTSAS
LEONARD R. RAISH
JAMES P. RILEY
KATHLEEN VICTORY*
HOWARD M. WEISS

* NOT ADMITTED IN VIRGINIA

FLETCHER, HEALD & HILDRETH, P.L.C.

ATTORNEYS AT LAW

11th FLOOR, 1300 NORTH 17th STREET

ROSSLYN, VIRGINIA 22209-3801

(703) 812-0400

TELECOPIER

(703) 812-0486

INTERNET

FLETCHERHEALD@msn.com

FRANK U. FLETCHER
(1939-1985)
ROBERT L. HEALD
(1956-1983)
PAUL D.P. SPEARMAN
(1936-1962)
FRANK ROBERSON
(1936-1961)
RUSSELL ROWELL
(1948-1977)

RETIRED
EDWARD F. KENEHAN

CONSULTANT FOR INTERNATIONAL AND INTERGOVERNMENTAL AFFAIRS
SHELDON J. KRYS
U. S. AMBASSADOR (ret.)

OF COUNSEL
EDWARD A. CAINE*

WRITER'S NUMBER
(703) 812-

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March 22, 1996

VIA HAND DELIVERY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
Room 222
1919 M Street, N.W.
Washington, D.C. 20554

DOCKET FILE COPY ORIGINAL

Re: Amendment of Subparts B, and F, Part 90 of the Commission's Rules to permit the transmission of safety alert signals or frequencies used for Non-Government radar operations RM-8734

Dear Mr. Caton:

On behalf of the Radio Association Defending Airwave Rights, Inc. (RADAR), we are filing an original and five (5) copies of its Supplementary Comments in the above-referenced matter.

Very truly yours,

FLETCHER, HEALD & HILDRETH, P.L.C.

George Petrutsas
Counsel for Radar Association
Defending Airwave Rights, Inc.

GP:cej
Enclosures
cc: See Service List (w/enc.)

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ORIGINAL

BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Amendment of Subparts B and F, Part 90, of the Commission's Rules to permit the transmission of safety alert signals on frequencies used for Non-Government radar operations	)	RM-8734

To: The Commission

MOTION TO ACCEPT SUPPLEMENTARY COMMENTS

The Radio Association Defending Airwave Rights, Inc. (RADAR), by counsel, hereby requests the Commission to accept and consider the attached Supplementary Comments, even though the comment period in the above-referenced matter has expired.

The purpose of this filing is to place in the public record the results of tests conducted on behalf of the petitioner designed to address certain technical issues raised by comments and reply comments. Therefore, it is respectfully submitted that the public interest would be served by the acceptance of the attached Supplementary Comments in that the Commission would have a more complete record upon which to base its decisions in this matter.

Respectfully submitted

RADIO ASSOCIATION DEFENDING
AIRWAVE RIGHTS (RADAR, INC.)

By: _____
Leonard Robert Raish
George Petrutsas

Its Attorneys

FLETCHER, HEALD & HILDRETH
1300 North 17th Street - 11th Floor
Rosslyn, Virginia 22209
(703) 812-0400

Dated: March 22, 1996
cej/lrr/lrr#4/radar2.plead

BEFORE THE

ORIGINAL

Federal Communications Commission

WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Amendment of Subparts B and F, Part 90,	)	RM-8734
of the Commission's Rules to permit the	)	
transmission of safety alert signals on	)	
frequencies used for Non-Government	)	
radar operations	)	

To: The Commission

SUPPLEMENTARY COMMENTS

The Radio Association Defending Airwave Rights (RADAR), by its attorneys, hereby submits the Supplementary Comments below to respond to issues raised in the course of the Comment and Reply Comments filed in the above-cited proceeding. These Supplementary Comments are also to put on the record an oral presentation addressing the aforementioned issues made by RADAR to the Wireless Telecommunications Bureau staff.

I. BACKGROUND

On October 24, 1995, RADAR filed a Petition for Rulemaking in the above cited matter. On December 13, 1995, the Commission put RADAR's Petition on 30 days Public Notice.[1] Comments and Reply Comments were received by the Commission in response to the Public Notice.[2] The Comments or Reply Comments supported the Petition. However, the Comments of Applied Concepts Inc. (ACI) and Reply Comments of COBRA Electronics Corporation (COBRA) raised certain technical questions and suggested that the Commission address these

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[1]See FCC Public Notice Report No. 2116, dated December 13, 1995.

[2]See Comments filed by Whistler Corporation, Applied Concepts Inc., Georgia Tech Research Institute, Inc., SANYO Technica USA, Inc., and Uniden America Corporation and Reply Comments filed by Cobra Electronics Corporation, RADAR Inc.

questions prior to proceeding to Rulemaking.

II. FURTHER TESTING AND TECHNICAL ANALYSES HAVE BEEN DONE TO ADDRESS ISSUES RAISED IN THE COMMENT AND REPLY COMMENT PERIOD

COBRA took the position that RADAR's proposal is meritorious but urged that "further testing, analyses, data and coordination must be obtained before the Commission issues a Notice of Proposed Rulemaking." COBRA Comments, p. 2. Applied Concepts, Inc. ("ACI") also supported the RADAR petition, but suggested that a potential interference source might be the conversion of the FM modulation of the proposed Safety Warning Transmitter System ("SWTS") at a 2 kHz bit rate into an incidental AM modulation by slop detection, that this AM component could be detectable by the radar as a spurious speed signal of about 28 MPH, and urged that this phenomenon should be investigated. RADAR believes that sufficient tests and analyses had been conducted that showed that the proposed SWTS is technically sound and a practical approach to enhancing highway safety. Nevertheless, in abundance of caution, RADAR engaged the Georgia Tech Research Institute (GTRI), the inventor of the proposed safety warning system, to conduct further tests and analyses to assure that all technical issues have been thoroughly addressed.

GTRI conducted extensive further tests. Several radar equipment models were tested under several set-ups and conditions. ACI supplied a number of its radar equipment models and one of its principals contributed to the design of the test program. The tests conducted, the equipment used, the results of the tests and analyses of those tests are described in Attachment A. Briefly, those tests confirm that the proposed SWTS is indeed technically quite feasible and would co-exist with other users of the band. Those tests further demonstrated that the potential

for interference from the proposed SWTS to police and to other radars is negligible to non-existent and that the phenomenon which concerned ACI, i.e., the possible conversion of the FM modulation into a spurious speed signal is most unlikely and did not materialize in the tests.[3]

III. TESTS AND ANALYSES PROVE COMPATIBILITY OF SWTS WITH POLICE RADARS

The petitioner is, of course, especially sensitive about the possibility that the SWTS might interfere with police radar operations. Therefore, the test conducted by GTRI focused on police radars. As detailed in Attachment A, most of the tests were conducted to determine possible interference to police radars operating in the stationary as well as in moving modes. Several radar equipment models were used. Their frequency stability was tested in the laboratory. The effect of battery drainage on the SWTS frequency stability, power output and control was also tested. On the basis of the test results and its analysis of those results, GTRI concluded that there will be no harmful interference, indeed no interference, to police radars when those radars and the SWTS system are operated in accordance with practices recommended by the National Traffic Safety Administration, which practices are widely accepted and followed by local police authorities. For example, GTRI has concluded that if a radar operator allows the target vehicle to approach his radar to the point where it can be observed that it is the only vehicle in the beam of his radar unit, the power to that radar unit from the target vehicle would be much higher than any interfering power from a SWT transmitter even if that transmitter were as close as 120 feet from the police radar.

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[3]The tests conducted, the methodology employed, the equipment used and the results were described to staff members of the Commission's Wireless Telecommunications Bureau at a conference held for that purpose at the Commission's offices on March 14, 1996. See Attachment A hereto.

IV. CONCLUSION

In conclusion, the questions and concerns raised in the Comment and Reply Comment cycle have been addressed with positive results. Noting these positive results and since there was clear support without objections for the Petition filed by RADAR, the Commission is urged to proceed to Rulemaking in the above cited matter.

Respectfully submitted

RADIO ASSOCIATION DEFENDING
AIRWAVE RIGHTS (RADAR, INC.)

By: _____
Leonard Robert Raish
George Petrutsas

Its Attorneys

FLETCHER, HEALD & HILDRETH
1300 North 17th Street - 11th Floor
Rosslyn, Virginia 22209
(703) 812-0400

Dated: March 22, 1996

cej/lrr/lrr#4/radar.plead

ATTACHMENT A

Report on Investigation of
Interference Potential of the
Safety Warning Transmitter System

Investigation of Interference Potential of the Safety Warning Transmitter

Prepared for Presentation to the Federal Communications Commission

by

Gene Greneker III, Principal Research Associate
Georgia Tech Research Institute
Atlanta, GA 30064

1.0 Background

Tests were conducted using the Safety Warning Transmitter (SWT) developed for RADAR, Inc. to determine the potential of interference posed to other users in the 24.1 GHz band. Of particular concern was the potential of interference to police radars. Applied Concepts, Inc. (ACI), a police radar manufacturer, filed comments on the RADAR petition to the Federal Communications Commission (FCC) to allow operation of the SWT at 24.1 GHz, as did Cobra, Inc., a radar receiver manufacturer. Specifically, their response was to a requested amendment of Subparts B and F, Part 90, of the Federal Communications Commission's Rules to permit the transmission of safety alert signals on frequencies used for Non-Government radar operations.

The comments filed by ACI and Cobra raised issues regarding the potential for interference to other users in the band, specifically the effects of the frequency modulation used by the SWT to transmit digital safety warning data. The Georgia Tech Research Institute (GTRI) was contracted by RADAR to perform testing to determine if there was the potential for interference consistent with the speculative comments filed with the FCC by ACI and Cobra.

Contact was made between the GTRI project director, Gene Greneker, and ACI's principal, Allen Mead. Mead offered to supply four radars for testing, and suggested that stationary and driving testing be performed rather than laboratory testing. The four radars supplied by Allen Mead were:

1. ACI - Stalker
2. Decatur - Range Master
3. Kustom - KR-10
4. MPH, Inc. - K-55

Each of the supplied radars was designed to operate on a frequency of 24.150 GHz. Each has a digital display scaled to approximately 72 Hz of Doppler shift per mile-per-hour of target speed and an audio monitor that allows monitoring of the received Doppler audio.

2.0 Testing of Police Radars Operating in the Stationary Mode

The SWT was setup at GTRI's Cobb County Research Facility on a tripod that elevated it approximately 9 feet above street level. Each radar was mounted in a test vehicle, one at a time, and tested in both the stationary and moving mode. All test were conducted with the radar and SWT antennas in almost boresighted alignment. There was no effect of the SWT on the Decatur, Kustom, or MPH radars in any mode for ranges as small as 50 feet from the SWT. The ACI Stalker did experience some interference out to a range of 120 feet from the SWT. At a range of 50 feet the ACI Stalker displayed a speed of 26 miles per hour and the SWT modulation could be heard in the Doppler audio monitor. The test vehicle was moved back from the 50-foot point and the test was repeated at 25-foot intervals to a range of 125 feet. At 75 feet, the Stalker displayed a speed of 53 MPH and the SWT modulation could be heard in the audio monitor. At a range of 100 feet no speeds were displayed nor was SWT modulation heard from the audio monitor. At a range of approximately 125 feet, a speed of 79 miles per hour was displayed and the SWT modulation could be heard in the audio monitor. The test vehicle was moved to a range of 180 feet and no modulation was heard, nor was any false reading displayed. The loss of SWT signal at 100 feet and the reacquisition at 125 feet was thought to be due to a multipath null at the 100 foot range.

The ACI Stalker is a homodyne radar that is optimized for sensitivity. The signal processor uses digital signal processing techniques, and when no target is in the beam the radar appears to apply full gain so that the noise is triggering a maximum number of bits in the analog-to-digital converter of the signal processor. Thus, with full gain the radar did detect the SWT's 2.0 kHz modulation out to a range of approximately 125 feet. However, it was noticed that when random target vehicles passed the radar, the signal processor "locked" on to the passing vehicle and no effects of interference from the SWT were seen until the target vehicle left the beam, at which time the false display occurred again and the SWT's Doppler modulation could again be heard in the audio monitor.

The test results showed that the ACI Stalker radar was the only unit that received the SWT modulation, and that occurred only when no other target was in the radar beam and only after the Stalker's signal processor gain was at maximum. Under full-gain conditions the Stalker is capable of tracking a vehicle a distance of 1 to 2 miles.

Allen Mead was asked what range of SWT modulation detection would be acceptable. He stated that if the SWT did not interfere when further than "100 feet or so," he would agree that there was no real problem.

3.0 Testing Police Radars in the Moving Mode

All radars were tested in the moving mode. The test vehicle containing each radar was driven at a speed of 30 miles per hour past the SWT during operation. None of the radars

experienced any interference in the moving mode.

4.0 Laboratory Testing of the Test Radars for Stability

Each of the test radars was tested in the laboratory for frequency stability. There was concern that if the Radar's carrier frequency drifted down from the police radar band center of 24.150 GHz toward the 24.100 GHz frequency assigned to the SWT, interference could occur. The starting frequency of each radar was measured, and the ending frequency of each radar was measured after 30 minutes of warm-up. The results of the stability testing is shown in Table I.

Table I. Drift Statistics of Police Radars

Radar Type	ACI Stalker	Decatur R. M.	Kustom KR-10	MPH K-55
Start Frequency (GHz)	24.149	24.171	24.166	24.158
End Frequency (GHz)	24.134	24. 143	24.164	24.156

The Decatur R. V. Range Master experienced the worst drift; 28.3 MHz over the 30-minute time period. However, it was the ACI Stalker that drifted the lowest in the band toward the SWT frequency during the test period. None of the radars drifted lower than 34 MHz above the SWT frequency thereby reducing the possibility that there would be direct interaction between radar carriers.

5.0 Low Battery Conditions

Cobra, Inc., in their comments to the Commission, stated a concern that the SWT may operate out of control under low battery conditions. The SWT was tested to determine the effects of low battery voltage on both the control computer and the transmitter of the SWT. SWT operating voltage was lowered gradually while the power output and frequency of the transmitter were monitored. In addition, the function of the control computer was also monitored. Table II shows the results of voltage sensitivity testing.

Table II. The Effects of Decreasing Input Voltage on the SWT Frequency, Power Output and Control

Input Voltage (Volts)	13.8 Volts	9.0 Volts	7.0 Volts	6.0 Volts
Frequency (GHz)	24.098 GHz	24.089	24.085	No emission
Computer Control	Yes	Yes	Yes	No

Voltage sensitivity testing was begun with a fresh charge on the SWT prototype's 12 volt, 7 Amp-Hour Gel-Cell Battery. It had been determined that the SWT control computer ceased operation at 6.5 volts and that the transmitter ceased operation at 6.0 volts. Thus, an additional test was conducted to determine how long the transmitter would operate, i.e., while there was no control computer operator with an input voltage level between 6.5 volts and 6.0 volts. The battery discharge curve was monitored over time. The voltage level of the battery held very constant until late into the tests. The battery output voltage reached the 6.5 volt threshold approximately 14 hours and 30 minutes after battery discharge rate testing had begun at approximately 05:46:30 hours the morning of the test. At 6.5 volts, the control computer ceased operation and modulation of the SWT

ceased. The battery dropped to an output level of 6.0 volts at approximately 05:52 hours. Thus, the time that the SWT was not under modulation and control of the computer was a period of approximately six minutes. During the six minutes the SWT was transmitting a continuous wave (CW) carrier at reduced power output. Thus, it is thought that the operation of the SWT during the very short interval between the loss of the control computer and transmitter cut-off should be of no concern to the user's who share the band with the SWT. This result has been noted, and a voltage monitor will be included in the production model of the SWT to turn the system off when the battery reaches a discharged state but before control of the transmitter is lost.

6.0 High Power Operation

Cobra, Inc. requested an explanation of why the SWT uses a high transmit power level. The SWT radar is used to detect the presence of traffic and measure the speed of traffic when it is used in the stationary mode. The $1/R^4$ losses encountered when the SWT is operated as a radar make the use of higher power highly desirable. The SWT prototype utilizes a power output of approximately 30 milliwatts and an antenna gain of approximately 17 dB. The detection range of an automobile is approximately 500 feet. This detection range is adequate to allow detection of an approaching automobile traveling at 65 miles per hour (95 feet per second) when the radar is sampling for one-half second once every five seconds. Any less power would require that the radar sample more often which would require that the radar duty cycle be increased. An increase in the duty cycle for radar operation is thought not to be desirable as any interference caused to another user would occur more often than 0.5 seconds every five seconds.

When the SWT is deployed on an emergency vehicle to warn motorists that the emergency vehicle is overtaking them, the antenna of the SWR in the motorist's vehicle is pointed forward (i.e., 180 degrees away from the overtaking emergency vehicle). The backlobe of the SWR antenna can provide a high degree of rejection of signals arriving from the rear. Thus, when operated in the moving mode, the SWT requires high power to couple enough power to allow motorists in the same lane to receive the safety warning message that is being received from behind them.

7.0 In Conclusion

On the basis of testing, it is concluded that there will be no interference to police radar when the SWT is operated in a manner consistent with the operating practices that are stressed by the National Traffic Safety Administration (NHTSA) in their fourty hour Police Radar Operator Training Course. Specifically, the NHTSA course on the establishment of tracking history instructs the radar operator to allow the target vehicle to approach to the point where it can be observed and it can be assured that it is the only vehicle in the beam. Under these conditions, as the tests results indicated, the power returned to the radar from the target vehicle will be much more than the interference power from the SWT, should a police officer choose to operate his radar within 120 feet of an active SWT. It is further concluded that the unattended operation of an SWT will not cause problems. The final production model will have a low-voltage sensor built into the system to turn off the SWT when the battery voltage drops below a pre-set threshold.

Investigation of Interference Potential of the Safety Warning Transmitter System

A Presentation by

Gene Greneker,
Principal Research Associate
Georgia Tech Research Institute

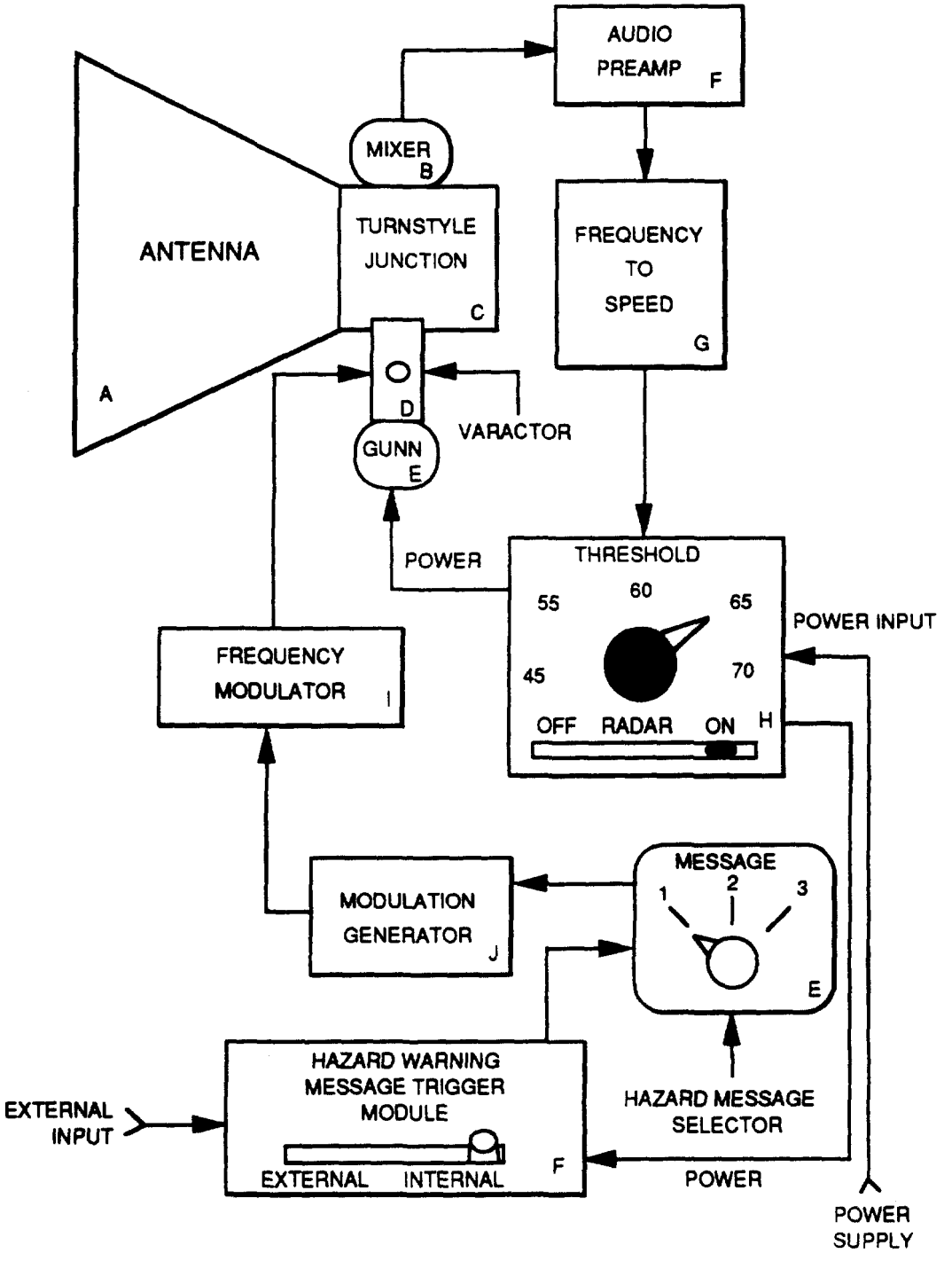
SWT Performance Specifications

- Transmitter Power Output ____ 30 mW
- Antenna Gain _____ 17 dB
- Polarization _____ Linear
- Type of Modulation _____ FM
- Total Frequency Excursion ____ 5 MHz
- Center Frequency _____ 24.1 GHz
- Total Warm-up Drift _____ 2 MHz

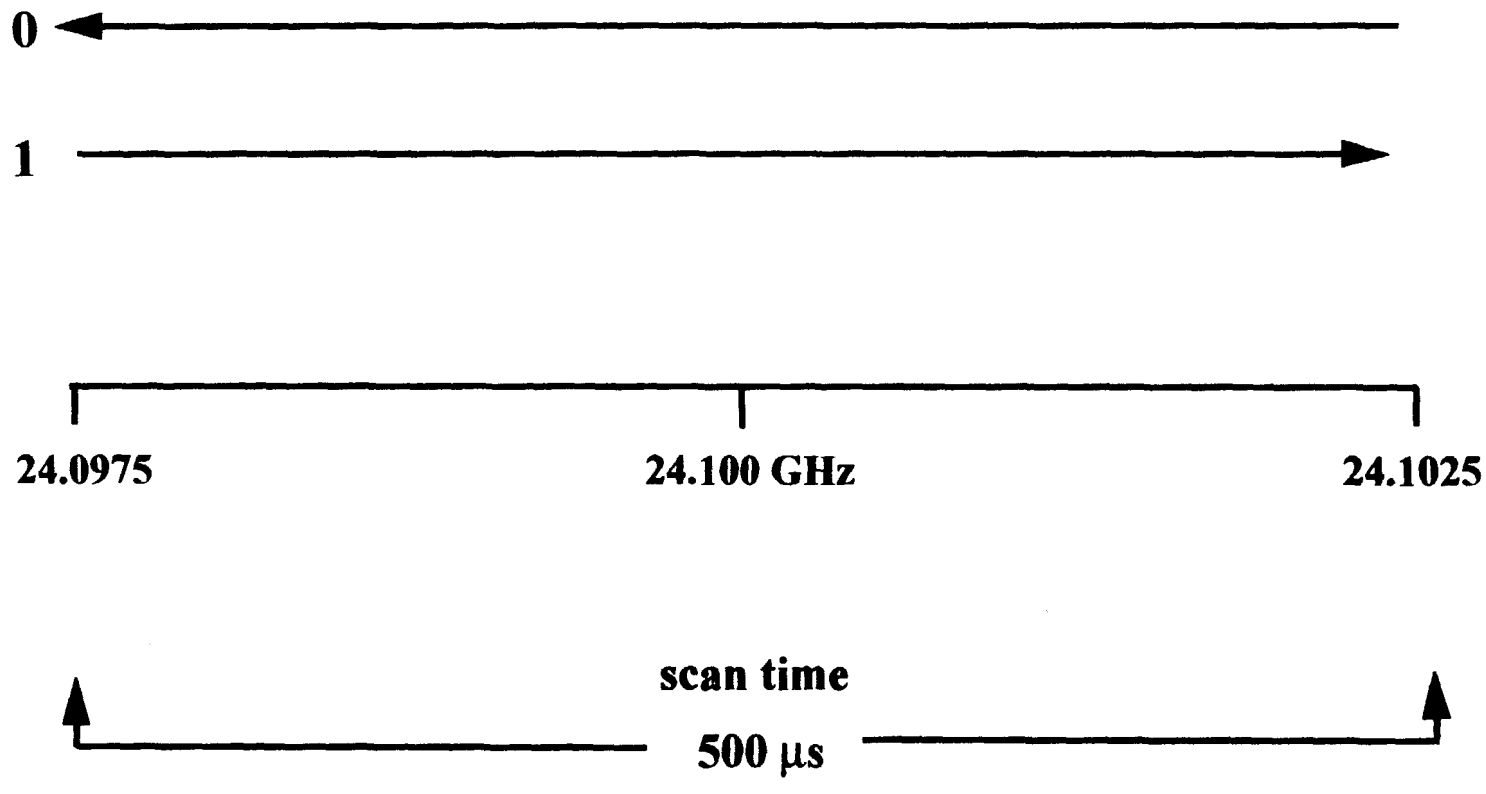
Modes of SWT Operation

- **RADAR** - ***senses vehicle presence or vehicle above speed***
  - **Reduces spectrum clutter**
  - **Saves battery**
- **Timed** - ***allows 4 time periods within 24 Hrs***
  - **Ensures transmission only when needed**
- **Continuos transmits until turned off**
- **Contact closure** - ***transmits only when triggered by event***

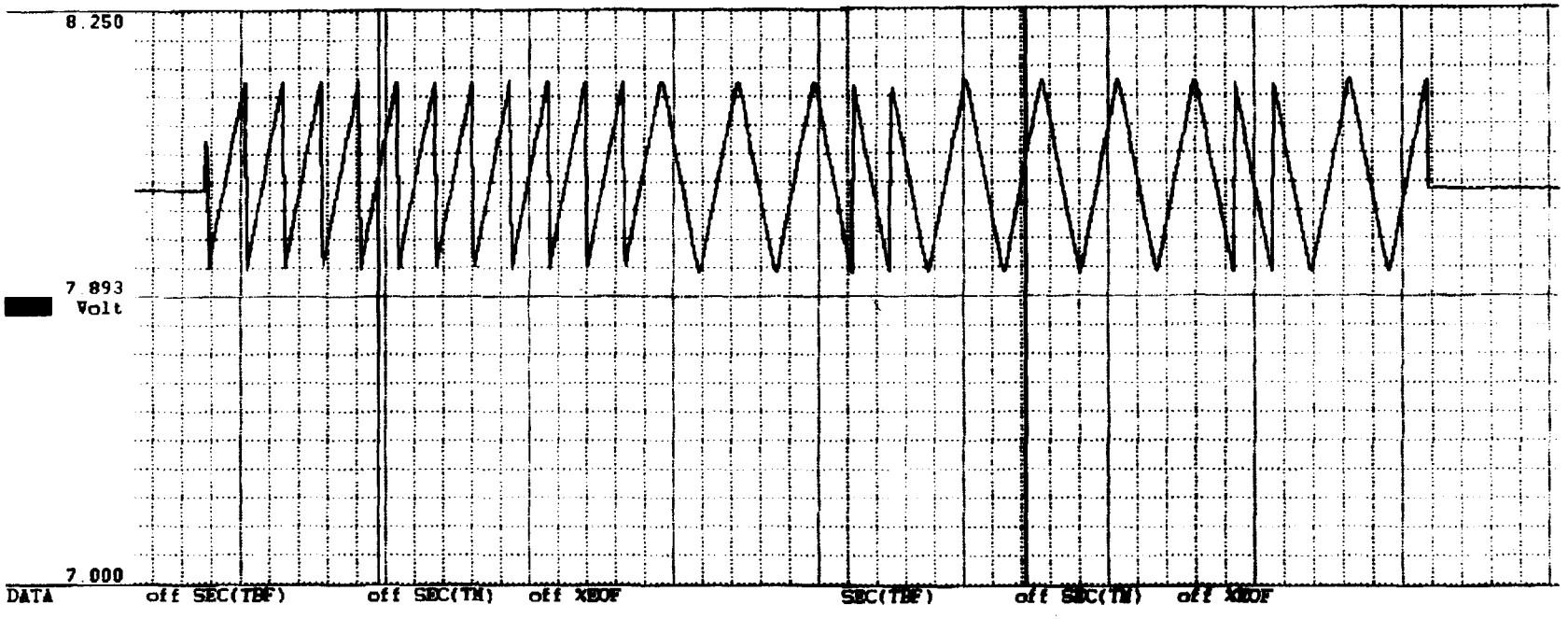
Use of Homodyne Radar as Cueing Device and FM-Safety Warning Transmitter System



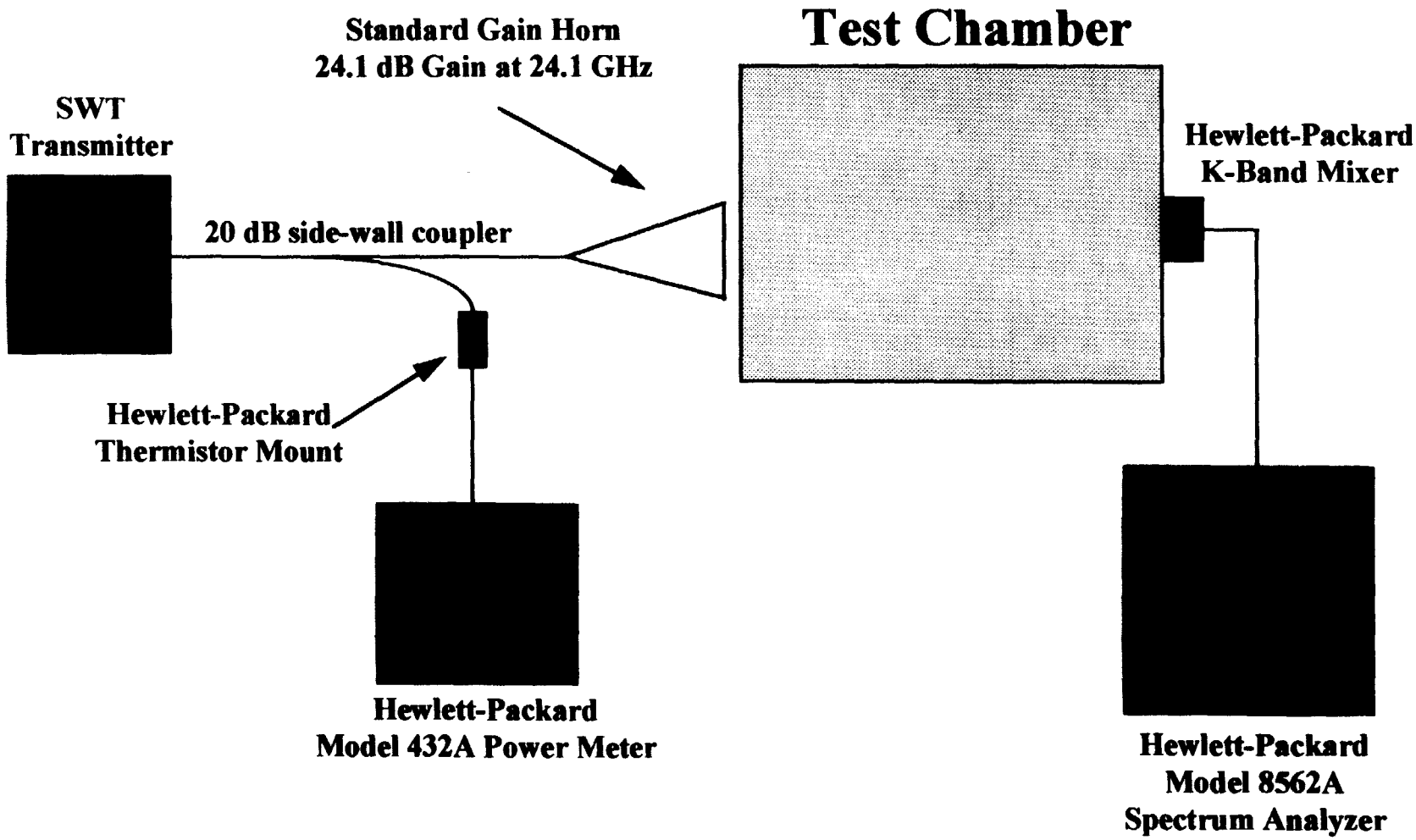
Modulation Scheme



Waveform Applied to Transmitter



SWT Horn Gain Measurement - 1



DS993-KLL

Measured Values - 1

- **Signal Generator Output:** ***3.26 dBm***
- **Measured Cable and Transition Loss:** ***- 3.26 dB***

- **Signal Generator Output at 20 dB Coupler** ***0.0 dBm***

- **Measured Output at - 20 dB Coupler Port** ***-20.0 dBm***

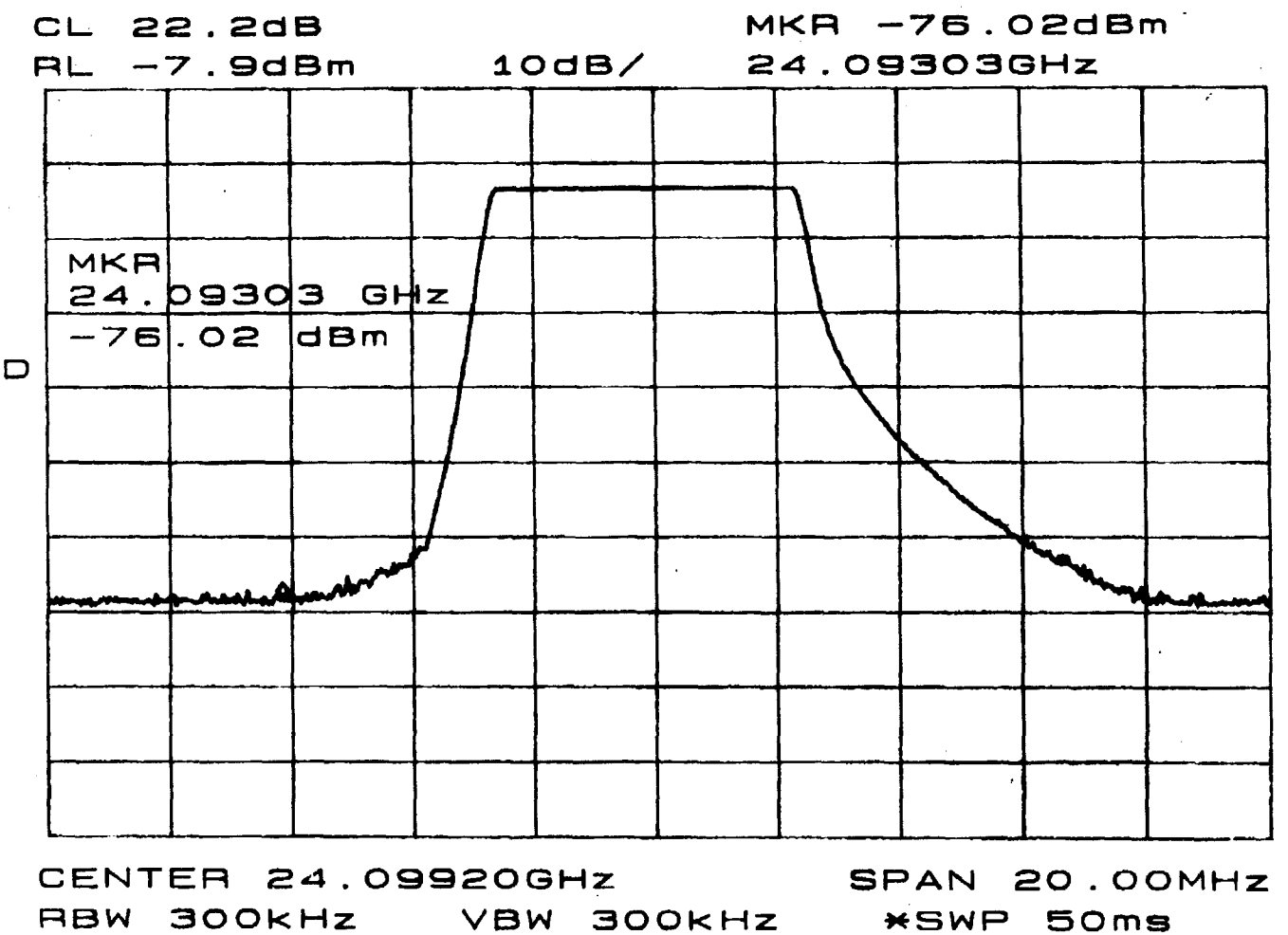
- **Gain of Standard Gain Horn @ 24.1 GHz** ***24.7 dB***

- **Power Measured by Spectrum Analyzer** ***-29.18 dB***

Measured Values

➤ **Signal Generator Output at Horn**	***0.0 dBm***
➤ **Power Measured using SG Horn**	***- 29.18 dBm***
➤ **Power Measured with SWT Horn**	***-37.35 dBm***
➤ **Difference between SWT and SG horns**	***8.17 dB***
➤ **Gain of SG Horn @ 24.1 GHz**	***24.7 dB***
➤ **Estimated Gain of SWT Horn Antenna**	***16.5 dB***
➤ **Advertised Gain of SWT Horn Antenna**	***17.0 dB***

SWT Spectral Footprint



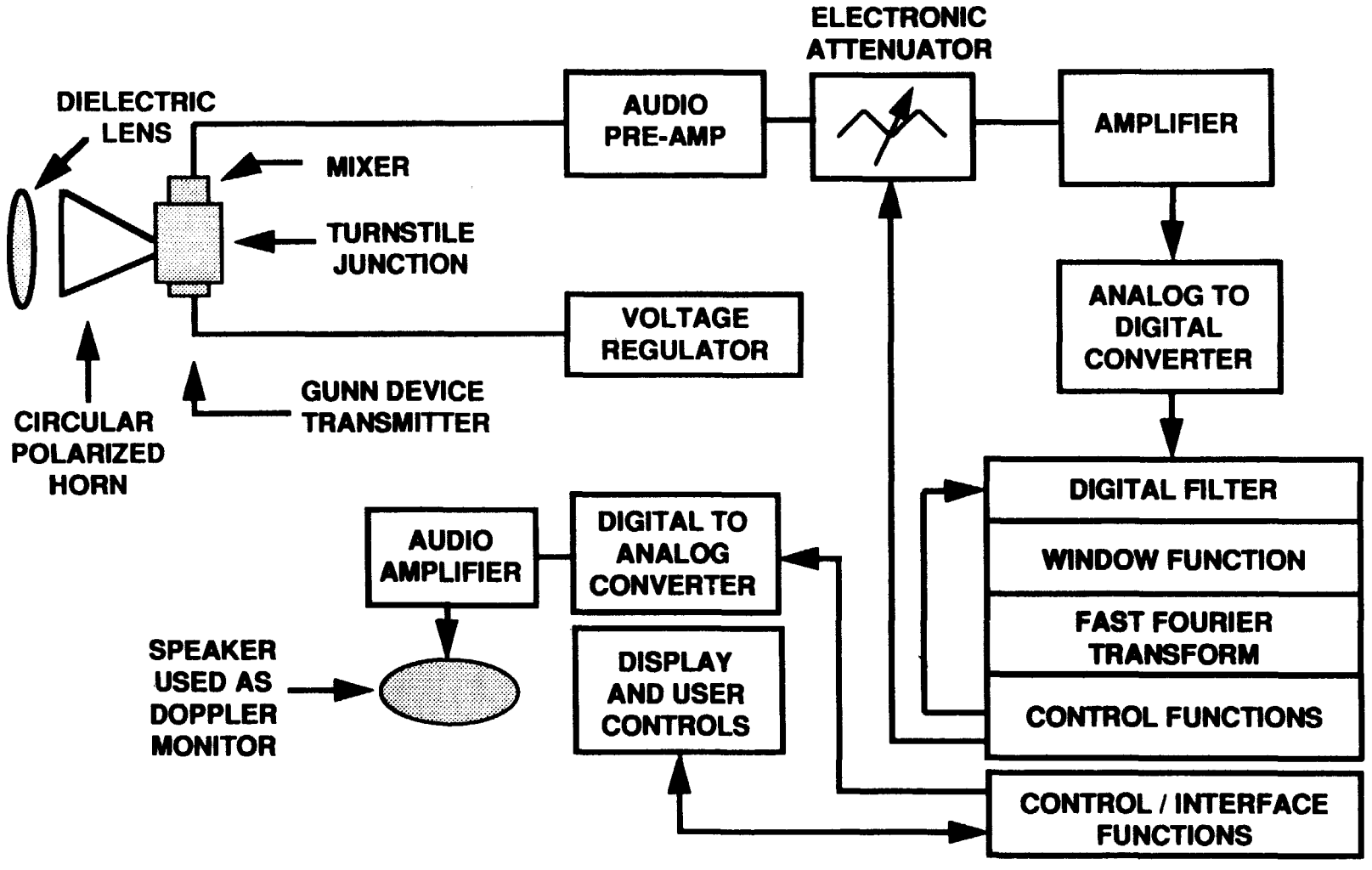
Police Radars Tested for Interference

[redacted]

- **Applied Concepts Inc.** — ***STALKER DUAL***
- **Decatur Electronics Inc.** — ***M.V. Range Master***
- **MPH Inc.** — ***K-55***
- **Kustom** — ***KR-10***

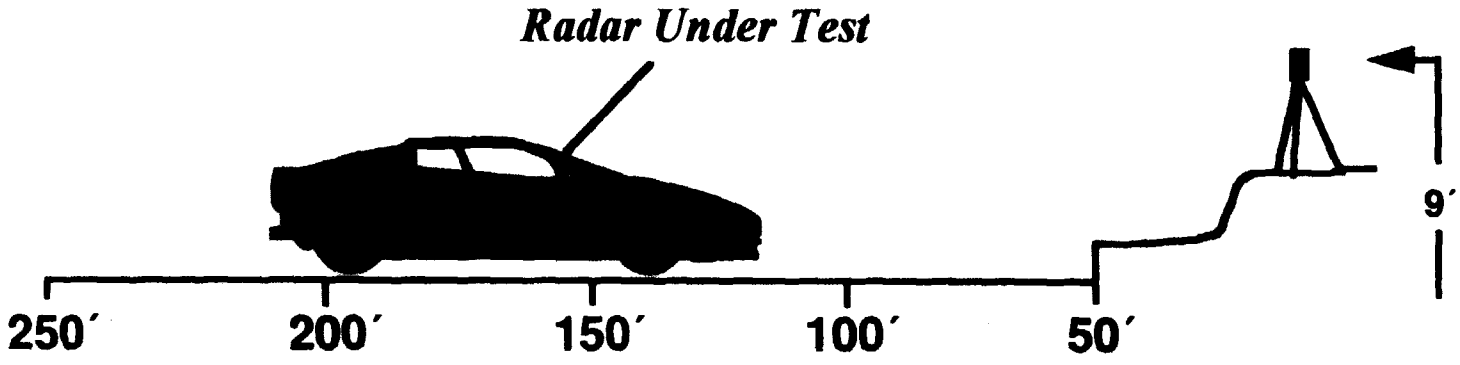
DS993-KLL

DSP Police Radar Block Diagram



Road Testing of Radars - 1

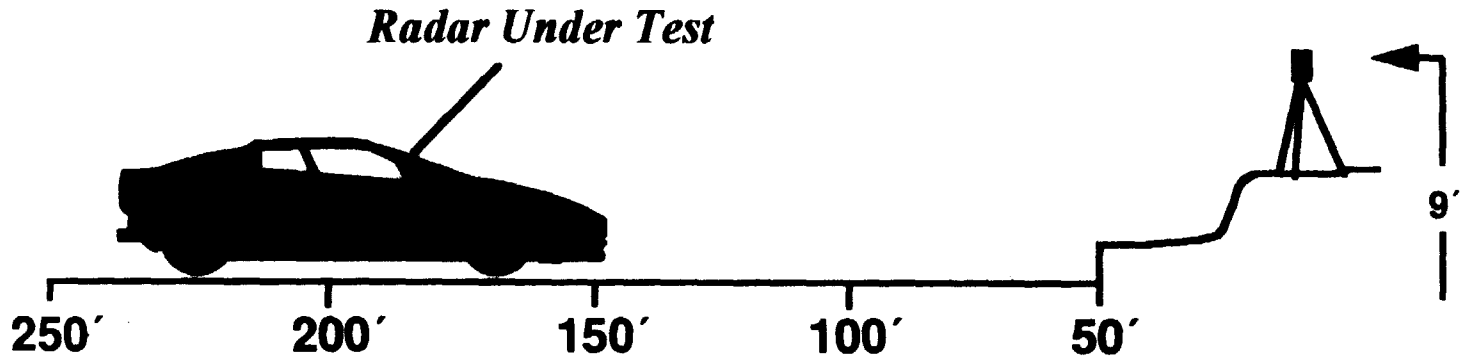
- **Stationary Mode Tests**



Road Testing of Radars - 2

- **Stationary Mode Tests**
  - **Applied Concepts Stalker Dual**

No Detection of SWT Transmitter at 180′



DS993-KLL